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The crustal structure of the Northeast Greenland continental shelf across the extension of the West Jan Mayen Fracture Zone

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Between August and October 2017, the German research vessel Maria S. Merian acquired geophysical data along the Northeast Greenland continental margin during its cruise MSM-67. This included seismic reflection and wide-angle/refraction data as well as potential field data. In comparison to the conjugate mid-Norwegian margins, the Northeast Greenland continental margin is less well studied. Hence, one of the key objectives of the expedition was to improve the understanding of the opening of the Northeast Atlantic Ocean and the evolution of the conjugate margin pair. One particular goal of the experiment was the mapping of the lateral extent of magmatism associated with the opening and how this relates to margin segmentation.

Seismic refraction line BGR17-2R2 runs on the shelf and parallel to the coast of NE Greenland. It crosses the landward extension of the West Jan Mayen Fracture Zone that separates the seafloor spreading along the Mohn's Ridge in the north from the Kolbeinsey Ridge in the south. A total of 29 ocean bottom seismometers (OBS) equipped with a hydrophone and three-component geophones were deployed along the 235-km-long line. The seismic source was a G-gun array with a total volume of 4840 cubic inches (79.3 L) fired every 60 s. In the central and northern part of the line, two older seismic refraction profiles are crossed (lines AWI2003-500 and 400, respectively), which run perpendicular to the margin and can be used for lateral correlation of the crustal structure.

For the initial analysis, a velocity model was developed by forward and inverse modeling of travel times using the program RAYINVR. Later, a travel time tomography was carried out employing the code Tomo2D and performing a Monte Carlo analysis with 100 inversions from which an average model was calculated. The models show a 1-to 3-km-thick sedimentary column with velocities ranging from 1.6 to 4.0 km/s. In the central and northern part, a 1-km-thick layer with velocities around 4.6 km/s is underlying the sediments and is interpreted to consist of volcanic material. Below and extending along the entire length of the line, velocities of 5.6 km/s are observed in a

layer that is ~2 km thick. The crystalline basement has a depth around 5 km with higher velocities in the north (6.5 km/s) than in the south (6.3 km/s). High lower crustal velocities (>7.2 km/s) are observed along the entire line and either indicate magmatic underplating or lower crustal sill intrusions. The Moho depth is seismically constrained along the central part of the line where it is 30 km. Gravity modeling suggest a depth of 35 and 27 km at the southern and northern limit of the profile, respectively. Within the zone of the landward extension of the West Jan Mayen Fracture Zone, a decrease in mid-crustal velocities by 0.2 km/s is observed. Slightly to the north of the fracture zone, a 50-km-wide zone with increased mid-and lower crustal velocities may indicate an igneous center in an area where the upper volcanic layer is shallowest.